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Redescription of *Bolbosoma capitatum* (Acanthocephala: Polymorphidae) from False Killer Whale off Vancouver Island, with Taxonomic Reconsideration of the Species and Synonymy of *B. physeteris*

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ABSTRACT: Many individuals of the acanthocephalan *Bolbosoma capitatum* von Linstow (1880) Porta, 1908 were collected from a stranded false killer whale, *Pseudorca crassidens* (Owen, 1846), off Vancouver Island, British Columbia, Canada, in 1989. This material provided the source of the first comprehensive description of the species, whose identity has been in dispute for over 100 yr. Many specimens collected from whales in 18 locations in the Mediterranean and off Faeroe Islands, North and South America, Caribbean, Africa, Great Britain, Japan, and Australia were examined and determined to belong to *B. capitatum*. Specimens of *Bolbosoma physeteris* Gubanov, 1952 collected from the same type host and locality listed in the original description were also determined to be *B. capitatum*, making *B. physeteris* a junior synonym. The most important determining characters are proboscis armature and variations in the spination of the area between the anterior and posterior cephalic bulbs.

KEY WORDS: *Bolbosoma capitatum*, redescription, Canada, worldwide variability, *B. physeteris*.

Polymorphid acanthocephalans belonging to *Bolbosoma capitatum* (von Linstow, 1880) Porta, 1908 have been reported from various species of whales in widely separated parts of the world over the last 100 yr. The original Italian literature describing *B. capitatum* is based on many specimens collected from one 4-m pilot whale, *Globiocephalus melaena* (Traill, 1809), in the unusual Meditarranean location of "Sea" (Bay) of Genoa. The above observers reported the confluence of the anterior and posterior cephalic fields of spines. The poor initial description of von Linstow (1880), based on specimens from false killer whale, *Pseudorca crassidens* (Owen, 1846) from an unknown location, made no reference to any spines connecting the 2 cephalic fields of spines for which he was criticized by Sabbatini (1895).

Meyer (1932) based his description on Porta's (1908) description and included the Faeroe Islands, East Atlantic, as an additional typical location. Petrochenko (1958) recasted Meyer's (1932) description as did Delyamure (1955) (with alterations), and Yamaguti (1963) quoted Meyer (1932) and Petrochenko (1958). None of these authors examined new material.

In the meantime, *B. capitatum* lacking connecting spines between the 2 cephalic fields was reported from many other parts of the world without making reference to the fact that this material differed from Porta's (1908) description of *B. capitatum* (with rows of connecting spines). In contrast, Gubanov (*in* Delyamure, 1955) described a new species, *Bolbosoma physeteris*, from sperm whale, *Physeter catadon* Linnaeus, which was primarily differentiated from *B. capitatum* by the lack of spines connecting the 2 cephalic fields. It was clear that a complete evaluation of variability in this and other significant taxonomic characteristics, e.g., proboscis armature, was needed to assess the identity of these forms compared to a comprehensive description that removes all the inconsistencies and inadequacies marring previous accounts. This report attempts to accomplish those objectives.

Materials and Methods

A false killer whale stranded on the west coast of Vancouver Island, British Columbia, Canada, on 1 October 1989 yielded many acanthocephalans identified as *B. capitatum*. Worms were extended, fixed, stained in Mayer's acid carmine, dehydrated in ascending concentrations of ethanol, cleared in graded terpineol—100% ethanol, and whole mounted in Canada balsam.

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Measurements are in micrometers unless otherwise stated. The range is followed by mean values (in parentheses). Width measurements refer to maximum width unless otherwise stated. Body (=trunk) length does not include neck, proboscis, or male bursa. The male reproductive system occupies the area between the anterior margin of the anterior testis and the posterior end of the trunk. Egg measurements are made of the outer shell of fully developed acanthors through the body wall of females. Specimens have been deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland; Dr. J. R. Lichtenfels, Curator.

A few other specimens from our Vancouver material were processed for SEM (Fig. 1) at Dr. Sherwin S. Desser's laboratory, University of Toronto, Canada. Specimens received in absolute ethanol were rehydrated and fixed using phosphate buffered 2.5% glutaraldehyde, postfixed with phosphate buffered 1.0% osmium tetroxide, dehydrated through an ascending ethanol series, dried by sublimation using Peldric II (Pelco International, no longer commercially available), mounted on aluminum specimen stubs, coated with gold/palladium, and examined using a Hitachi S2500 scanning electron microscope operated at 20 kV.

Other specimens examined were collected from various species of whales in the Meditarranean, Faeroe Islands, North and South America, Caribbean, Africa, Great Britain, Russia, Japan, and Australia (Table 1). Some of the British, East Atlantic, Japanese, and Australian materials were processed and mounted with permission.

Results

Our Canadian material is recognized as representing the polymorphid acanthocephalan *Bolbosoma capitatum*. The description below is based solely on material obtained from the false killer whale that was stranded on the west coast of Vancouver Island, British Columbia, Canada, in 1989.

Bolbosoma capitatum (von Linstow, 1880) Porta, 1908 (Figs. 1–3)

Description

GENERAL: Polymorphidae; with characters of the genus *Bolbosoma* Porta, 1908. Shared structures larger in females than in males. Trunk cylindrical, of medium length, and armed anteriorly in 2 cephalic fields separated by an area incompletely and variably free of spines. A constriction up to 4.0 mm long separates the bulbous posterior cephalic field from a long posterior trunk with almost parallel sides. Anterior cephalic bulb with up to 13 irregularly alternating circles of spines that become progressively smaller anteriorly, with the anteriormost spines being the smallest and in an almost perfect circle, delimiting the relatively narrowing bulb from the neck. The interbulbar area widens into a posterior cephalic bulb with up to 14 irregularly alternating circles of spines that are larger posteriorly and markedly larger than those of the anterior cephalic field.

The posteriormost circles of spines of the anterior cephalic field are usually incomplete laterodorsally and are made up of a few ventral spines that extend through the spine-free zone toward the posterior cephalic field of spines, to variable degrees (Figs. 1, 2), occasionally almost merging with it. Occasional spines may also extend anteriorly from the anterior margin of the posterior cephalic field into the bare zone between the 2 fields, also ventrally opposite above spines extending from the anterior field to occasionally almost connect both fields (Fig. 3). These variations contrast with the outer margins of the 2 cephalic fields that are invariably uniform and even.

Proboscis cylindrical, truncated-rounded anteriorly, broadest near its base, with 16–18 rows of 8–9 hooks each. Proboscis hooks of 3 types: anterior hooks medium sized with posteriorly directed simple roots shorter than blades; middle hooks largest with posteriorly directed robust simple roots longer than blades; posterior hooks spinelike, about as long as anterior hooks, and with laterally directed winglike roots. Prominent broadly conical neck almost as long as proboscis. Proboscis receptacle extends posteriorly beyond posterior cephalic bulb region, and the longer subequal lemnisci usually extend past the proboscis receptacle into the anterior portion of the trunk constriction. One specimen (a male) had a number of random cuticular plaques between the posterior cephalic bulb and the constriction.

MALES (based on 10 mature adults with sperm): Trunk 33.990–44.880 (38.620) mm long by 1.551–3.663 (2.332) mm wide. Anterior cephalic field 0.759–1.155 (0.917) mm long by 1.056–1.320 (1.191) mm wide with 6–13 (9.1) circles of at least 24–32 (29) spines each measuring 26–52 (41) long anteriorly and 104–130 (122) long posteriorly (Table 2). Posterior cephalic bulb 0.891–1.320 (1.129) mm long by 2.013–2.871 (2.455) mm wide with 7–12 (8.3) circles of at least 34–52 (45.8) spines each measuring 91–169 (133) long anteriorly and 130–208 (173) long posteriorly (Table 2). Total

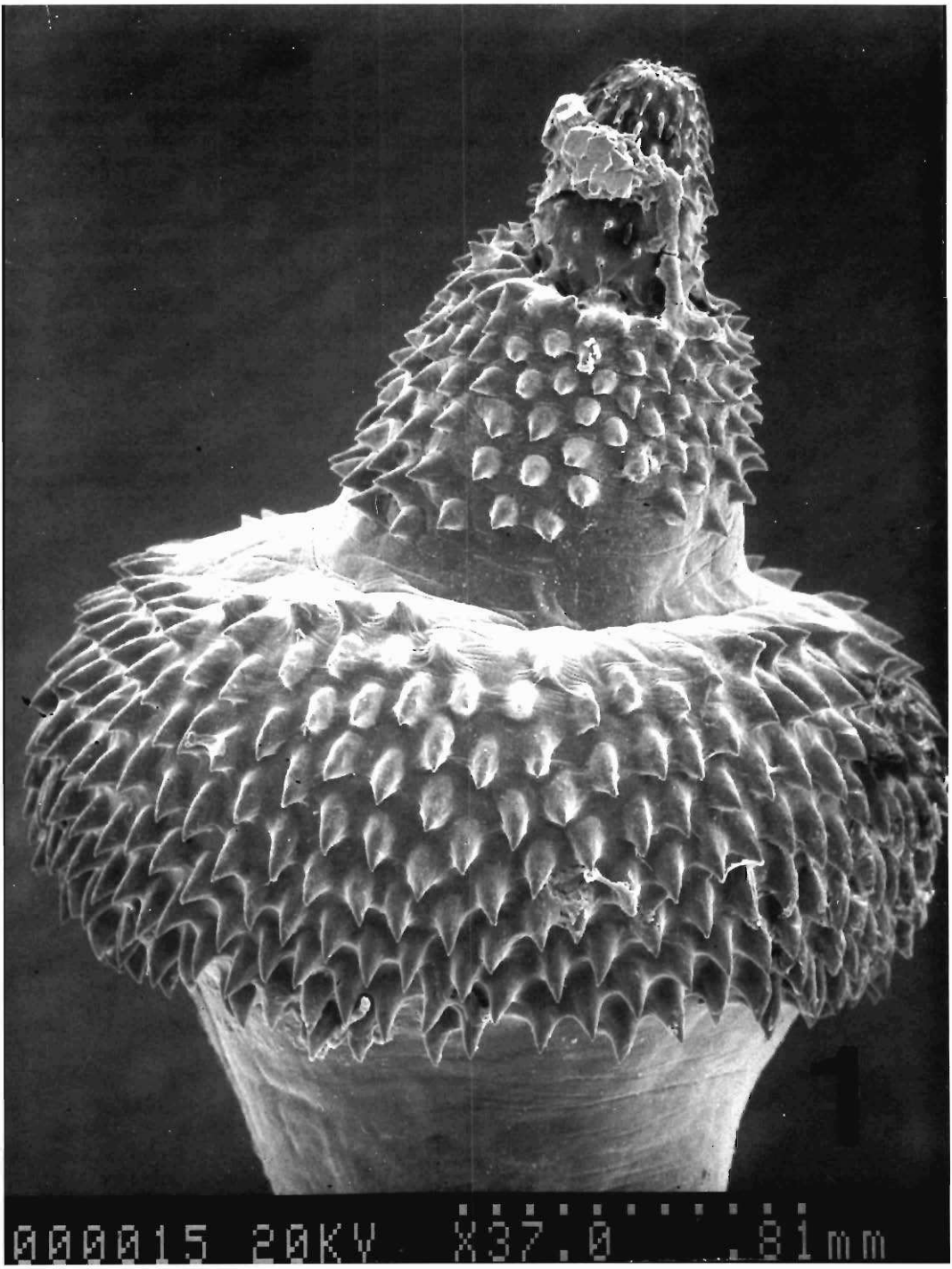

Figure 1. An SEM photo of the anterior portion of an individual *Bolbosoma capitatum* from a false killer whale, Vancouver Island, Canada, showing typical proportions of presomal parts, distribution of cuticular spines of the 2 cephalic fields, and some posterior extension of anterior bulbar spines ventrally (left center).

Table 1. Specimens of *Bolbosoma* examined.

Geographical location	Host species	Specimens	Identification		
		Number	Slides/ vials	By	As
Mediterranean	*Globiocephalus melaena*	2 F	S	Parona (1893)	*E. capitatus*
Sea of Genoa				Van Cleave	*B. capitatum*
Faeroe Islands	*Globiocephalus melaena*	2 M, 3 F	S	Amin	*B. capitatum*
North America					
Newfoundland	*Globiocephalus melaena*	2 juv.	V	Becklund	*B. capitatum*
Prince Edward	*Physeter macrocephalus*	3 F	S	Hoberg et al. (1993)	*B. capitatum*
Island	*Physeter macrocephalus*	6	S/V	Hoberg et al. (1993)	*B. capitatum*
Vancouver Island	*Pseudorca crassidens*	10 M, 10 F	S	Amin and Margolis	*B. capitatum*
		Many	V	(this paper)	
Caribbean	*Globiocephalus macrorhynchus*	3 M, 6 F	S	Hoberg	*B. capitatum*
South America					
Brazil	*Globiocephalus melaena*	2 M	S	Machado Filho (1964)	*B. capitatum*
Argentina	*Pseudorca crassidens*	3 F	V	Amin	*B. capitatum*
West Africa	*Steno rostratus*	1 juv.	V	NHM	*B. capitatum*
South Africa	*Pseudorca crassidens*	2 adults/1 juv.	V	NHM	*B. capitatum*
	Pseudorca crassidens	2 adults	V	NHM	*B. capitatum*
North Sea	*Pseudorca crassidens*	2 adults	V	Verkänfer	*B. capitatum*
Great Britain					
Cornwall	*Globiocephalus melaena*	2 juv.	V	NHM	*B. capitatum*
Lincolnshire	*Pseudorca crassidens*	4 adults	V	NHM	*B. capitatum*
Norfolk	Unknown cetacean	1 adult/2 juv.	V	NHM	*B. capitatum*
Scotland	*Pseudorca crassidens*	4 adults	V	NHM	*B. capitatum*
Russia					
Pacific Ocean	*Physeter catodon*	3 adults/2 juv.	V	Skrjabin	*B. physeteris*†
Japan					
Katsuura Bay	*Pseudorca crassidens*	3 M, 4 F	S	Kikuchi and Nakajima	*B. capitatum*
		6	V	(1991, 1993)	
Australia					
West Australia	*Pseudorca crassidens*	5 M, 5 F	S	Edmonds (1987)	*B. capitatum*
New South Wales	*Pseudorca crassidens*	4 adults	V	NHM	*B. capitatum*
Unknown location	*Physeter macrocephalus*	1 juv.	V	NHM	*B. capitatum*‡

* AHC, SAM: Australian Helminthological Collection, South Australian Museum, Adelaide, Australia (S. Pichelin, Curator); HCIOC: Helminthological Collection, Institute Oswaldo Cruz, Rio de Janeiro, Brazil (Dalynoronha, Curator); NBM: New Brunswick Museum, St. John, New Brunswick, Canada (D. McAlpine, Curator); NHM: The Natural History Museum, London, United Kingdom (Eileen Harris, Curator, Parasitic Worms Division); USNPC: United States National Parasite Collection, Beltsville, Maryland, U.S. (J. R. Lichtenfels, Curator); UV: University of Valencia, Valencia, Spain (T. Raga, Department of Animal Biology); VIGIS: VIGIS Museum; ZM: Zoological Museum, Berlin, Germany (Dr. Neuhaus, Naturhistorisches Forschungsinstitut, Museum für Naturkunde).

† Not *B. physeteris* but *B. capitatum.*

‡ Not *B. capitatum.*

length of cephalic fields including interbulbar area 1.980–2.640 (2.347) mm. Trunk constriction 1.980–3.465 (2.363) mm long by 0.528–1.155 (0.716) mm narrow. Neck 561–910 (757) long by 585–693 (634) wide. Proboscis 715–871 (775) long by 494–546 (519) wide with 16–18 (17.4) rows of 8–9 (8.4) hooks each. See Table 3 for measurements of hook length and diameter at base. Proboscis receptacle 2.640–3.366 (2.948) mm long by 396–495 (458) wide. Longer lemniscus 3.465–4.290 (3.988) mm long by 231–693 (419) wide; shorter lemniscus 2.970–3.696 (3.361) mm long by 264–693 (429) wide.

Testes ovoid, not contiguous, tandem; anterior testis, shortly posterior to trunk constriction; 1.254–2.310 (1.737) mm long by 0.693–1.089 (0.842) mm wide; posterior testis 1.419–2.145 (1.827) mm long by 0.594–1.254 (0.841) mm wide. Two pairs of long cement glands 18.310–26.400 (21.743) mm long by 264–660 (409)

Table 1. Extended.

Inner margins of bulbar spine fields	Source		Remarks
	Museum*	Accession no.	
Obscured	USNPC	6299	Some Parona material used by Sabbatini (1895), Porta (1906, 1908, 1909)
Confluent	UV	136, 286, 3	Locality first reported by Meyer (1932); in 1987, 1989
Extended	USNPC	59341	Bonavista Bay (Cowan, 1967)
Obscured	USNPC	82700	Near Covehead Harbor on north shore of island, in 1989
Obscured	NMB	10211	
Merging	USNPC		Off west coast of island, in 1989
Extended	USNPC	?	Mignucci-Giannoni (1996); Puerto Rico, Virgin Islands
Obscured	HCIOC	29832–29835	Originating from Paulista Museum
Merging	UV	RNP-1419	Off Tierra del Fuego
Obscured	NHM	1934.10.3.31	Near Cape Verde by Discovery Comm. in October 1925
Obscured	NHM	1982.1693–1702	At Tsitikamma Coastal Park, Cape Province by G. Ross
Extended	NHM	1982.138–167	
Confluent	ZM	4409	Original von Linstow material, received from Neuhaus
Obscured	NHM	1932.3.3.55–58	In January 1932
Extended	NHM	1935.12.30.294–303	At Donna Nook, N. Somercotes by F. C. Fraser in October 1935
Merging	NHM	1994.8.10.11–15	At Sherringham by P. Jepson in May 1991
Merging	NHM	1928.12.4.51–100	At Domoch Firth, Ross-shire by J.L.C. Musters & M.A.C. Hinton in December 1927
Extended	VIGIS	N17150, N17159	At K/K Podgornyi, Kuril Islands in June and August 1955; type locality and host of original description
Extended	USNPC	87344	In situ, received from Kazuya Nagasawa, NRIFSF, Shimizu, December 1995
Extended	AHCSAM	16307	In situ, at Augusta by E. Sedlak-Weinstein in July 1986
Extended	NHM	1985.2021–2031	At Crowdy Heads by K. Rohde
—	NHM	1952.12.5.52	By W. F. McIllroy

wide begin one behind the other just posterior to testes and end at posterior margin of Saeffftigen's pouch 1.089–2.310 (1.709) mm long by 0.561–1.254 (0.888) mm wide. Cirrus 0.990–1.320 (1.084) mm long by 0.759–1.254 (0.976) mm wide. Bursa 1.320–2.640 (1.907) mm long by 1.320–2.640 (2.061) mm wide.

FEMALES (based on 10 gravid specimens): Trunk 38.115–68.310 (49.046) mm long by 2.310–3.465 (2.796) mm wide. Anterior cephalic field 0.990–1.155 (1.047) mm long by 0.924–1.452 (1.240) mm wide with 9–13 (10.4) circles of at least 22–32 (27.7) spines each measuring 39–52 (48) long anteriorly and 117–182 (143) posteriorly (Table 2). Posterior cephalic bulb 0.990–1.584 (1.216) mm long by 1.353–3.234 (2.442) mm wide with 8–14 (9.5) circles of at least 36–52 (44.7) spines each measuring 130–182 (154) long anteriorly and 195–234 (210) long posteriorly (Table 2). Total length of cephalic fields including interbulbar area 2.310–3.135 (2.706) mm. Trunk constriction 1.650–3.630 (2.991) mm long by 660–990 (804) wide at narrowest point. Neck 0.594–1.040 (0.819) mm long by 594–754 (692) wide. Proboscis 767–949 (873) long by 494–559 (531) wide with 16–18 (17.2) rows of 8–9 (8.5) hooks each. See Table 3 for measurements of hook length and diameter at base. Proboscis receptacle 2.640–3.300 (3.036) mm long by 462–594 (495) wide. Longer lemniscus 4.026–5.379 (4.798) mm long by 198–495 (323) wide; shorter lemniscus 3.465–5.049 (4.217) mm long by 165–627 (409) wide. Ripe eggs fusiform with polar prolongation of fertilization membrane 130–169 (144) long by 32–39 (36) wide.

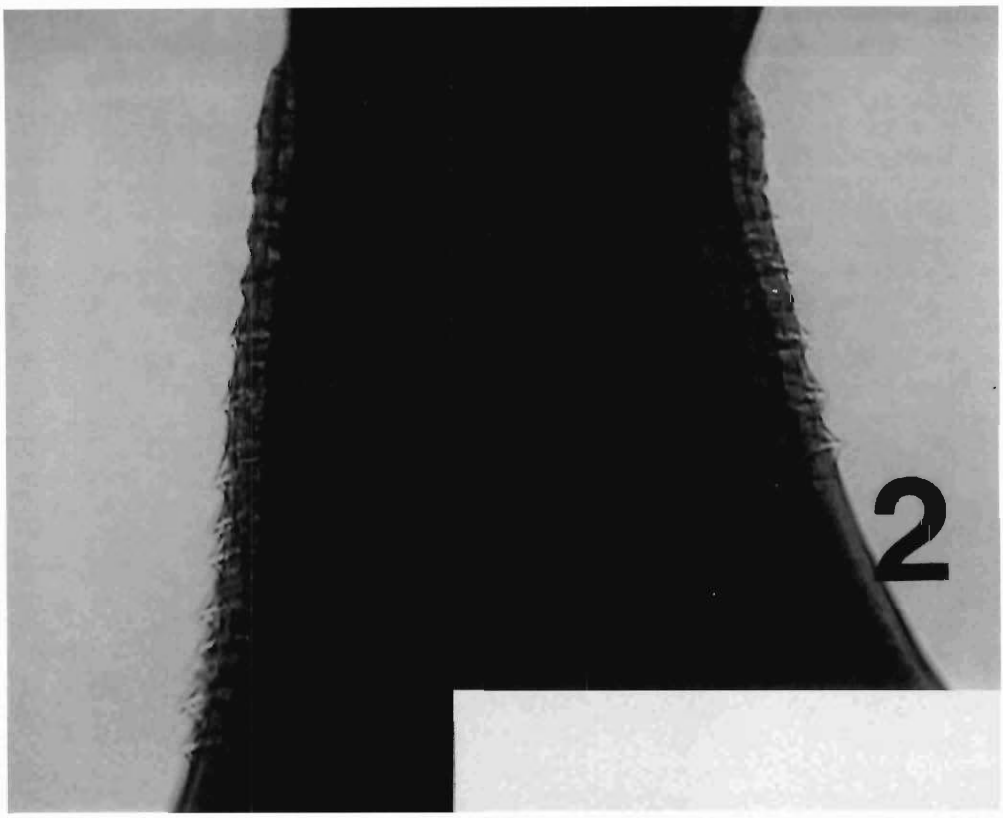

Figure 2. Interbulbar space of an individual *Bolbosoma capitatum* showing pronounced posterior extension of anterior bulbar spines ventrally (left).

SPECIMENS DEPOSITED: USNPC No. 87338 (19 slides and 2 vials).

OTHER MATERIAL EXAMINED: See Table 1.

OTHER SPECIMENS DEPOSITED: USNPC Nos. 87339–87341 (British specimens); USNPC No. 87344 (Japanese specimens); USNPC No. 87343 (Australian specimens); USNPC No. 87342 (Faeroe Islands specimens).

Many other specimens of *B. capitatum* collected from various species of whales in 17 other geographical locations were studied (Table 1). These locations cover practically the full range of geographical distribution of *B. capitatum* with the exception of Antarctica (Golvan, 1960; Dailey and Vogelbein, 1991). In all specimens where the inner margins of bulbar spine fields were not obscured, all collections included individuals having extended-merging fields (as described in our Vancouver specimens above) or confluent fields (the Faeroe Islands specimens).

Discussion

The 2 most important taxonomic characters, interbulbar spines and proboscis armature, are discussed in detail below.

INTERBULBAR SPINES: The early Italian literature describing *B. capitatum* (see Sabbatini, 1895; Porta, 1906, 1908, 1909) was based on Parona's (1893) many specimens collected from 1 pilot whale in the Mediterranean. Sabbatini (1895) made the initial but most definitive statement describing the variation in connecting interbulbar spines as between 0 and 2 rows. This account has been grossly overlooked in all the subsequent taxonomic literature that was content in referring to Porta's (1906, 1908, 1909) descriptions, which also overlooked it. Sabbatini (1895) stated that "more than anything else characterizing the worm . . . is an (interbulbar) area free of spines . . . that is always present, *sometimes can even be crossed by 1 or 2 oblique*

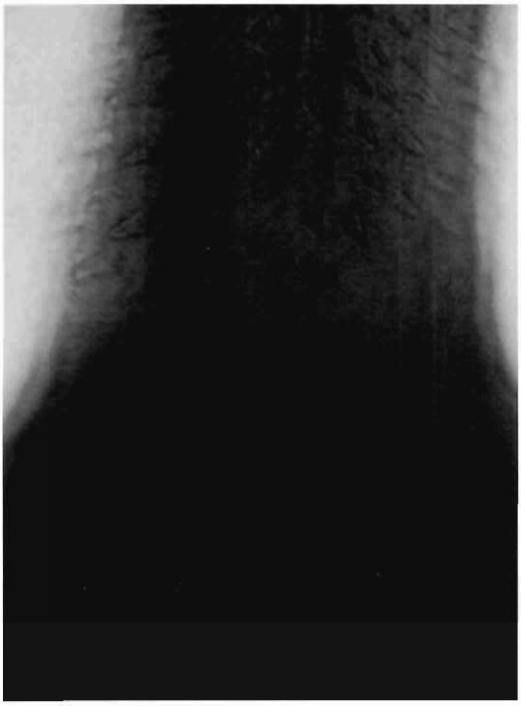

Figure 3. Ventral aspect of interbulbar space of an individual *Bolbosoma capitatum* showing merging of anterior and posterior bulbar spines.

Table 3. Size of proboscis hooks in 10 male and 10 female *Bolbosoma capitatum* from *Pseudorca crassidens*.

Proboscis hooks (from anterior)	Hook length		Hook diameter at base	
	Males	Females	Males	Females
1	68 (52–82)*	71 (52–78)	18 (13–26)	19 (13–26)
2	87 (78–96)	87 (78–91)	23 (20–32)	27 (26–30)
3	95 (91–104)	104 (91–104)	31 (26–39)	33 (26–45)
4	101 (85–109)	112 (98–130)	41 (26–52)	41 (39–45)
5	108 (91–118)	118 (104–143)	47 (39–52)	52 (45–58)
6	105 (91–130)	105 (104–111)	30 (20–39)	51 (45–58)
7	92 (78–104)	95 (78–104)	23 (20–26)	32 (26–39)
8	94 (85–104)	89 (78–104)	16 (13–20)	21 (20–26)
9	76 (65–91)	86 (65–104)	13 (13–16)	17 (13–20)

* Mean (range) in micrometers.

rows of spines. It is surprising that this has escaped Linstow who does not make any hint of it in his description nor does he give any illustration of it" (p. 3). Hoberg et al. (1993) stated that the 2 voucher specimens of Parona (USNPC 6299) had distinct fields of spines and that von Linstow (1880) described "2 fields of spines that were confluent ventrally." We are not certain about the status of the above Parona specimens, and note that von Linstow (1880) only stated that there were about 20 rows of spines on a "bell-shaped swollen receptaculum" (the bulb). Sabbatini (1895) examined 2 of von Linstow's (1880) specimens and found them with contiguous interbulbar ventral spines. In his formal description, Porta (1908) only acknowledged that the interbulbar space is "armed only ventrally with 1–3 oblique rows of spines." Meyer (1932) based his description of *B. capitatum* on Porta's (1908), and subsequent taxonomic accounts, e.g., Petrochenko (1958), Delyamure (1955), and Yamaguti (1963), were primarily based on Meyer's (1932) and made no reference to Sabbatini (1895). There is no evidence that any new

Table 2. Length of trunk spines in anterior and posterior cephalic fields of 10 male and 10 female *Bolbosoma capitatum* from *Pseudorca crassidens*.

Trunk spines (from anterior)	Anterior cephalic field		Posterior cephalic field	
	Males	Females	Males	Females
1	41 (26–52)*	48 (39–52)	133 (91–169)	154 (130–182)
2	55 (26–78)	80 (65–104)	140 (65–182)	160 (143–182)
3	70 (52–91)	95 (78–130)	148 (104–195)	167 (156–182)
4	83 (65–104)	104 (91–143)	149 (104–195)	174 (156–195)
5	90 (65–117)	111 (104–143)	154 (130–195)	179 (156–195)
6	101 (78–117)	119 (104–143)	159 (130–208)	185 (169–195)
7	109 (78–130)	126 (117–156)	166 (130–208)	191 (182–195)
8	116 (78–156)	130 (117–156)	167 (130–208)	199 (182–221)
9	130 (91–195)	137 (117–156)	171 (130–208)	206 (182–234)
10	122 (104–130)	143 (117–182)	173 (130–208)	210 (195–234)

* Mean (range) in micrometers.

specimens were examined by these authors. Porta's (1908) interpretation of Parona's (1893) specimens remains the ultimate source of information on the armature of the bulb in *B. capitatum.*

The specimens examined by us from our various sources throughout the world (Table 1) included individuals having extended or merging fields of bulbar spines or confluent fields in each collection. We consider all of these to be *B. capitatum* as they all fit within the now recognized range of variation for that trait of 0–3 oblique rows of interbulbar spines; 0–2 (Sabbatini, 1895) and 1–3 (Porta, 1906, 1908). Von Linstow (1880) may have actually observed only a few individuals with incomplete confluence of spines like ours from Vancouver. It is possible, but unlikely, that authors dealing with such specimens (Table 1) assigned them to *B. capitatum* after having considered Sabbatini's (1895) work but never mentioned it.

The controversy regarding the von Linstow (1880) specimens, e.g., what did he really observe, was resolved by the examination of 2 original materials from his *P. crassidens* study in the North Sea (Table 1). The larger of the 2 specimens showed considerable posterior and ventral extension of anterior bulbar spines, like our specimens from Vancouver (Figs. 1–3). The spine fields were connected ventrally accross the reduced interbulbar space with 1 longitudinal row of only 3 spines. One adjacent spine was positioned as though it represented an incomplete row. Dorsolaterally, 2 transverse "occasional" spines almost connected the 2 spine fields that appeared very close at 1 other point near where the opposite incomplete inner circles of bulbar spines were. Von Linstow's younger specimen showed some ventral merging of spine fields, but no confluence was evident. The full range of variation in interbulbar spines reported above (Table 1) appears to be represented in the 2 von Linstow specimens. The historical discrepancies that plagued the systematics of *B. capitatum* for so long are thus considered resolved.

The Russian specimens examined by us (Table 1) were collected by A. S. Skrjabin in 1955 from 2 sperm whales near the Kuril Islands and were labeled as having been identified in 1959. These specimens were probably obtained during the expedition referred to by Skrjabin (1959) and apparently are not the original ones based on which Gubanov (*in* Delyamure, 1955) described his new species, *B. physeteris,* in his thesis. The latter specimens were collected during an expedition conducted in 1950 in the same general area. Gubanov (1952, *in* Delyamure, 1955) distinguished *B. physeteris* from *B. capitatum* by the absence of confluence of bulbar spines in the former but not the latter species. Delyamure (1955) and Petrochenko (1958) concurred; otherwise, the 2 species are rather similar. Examination of the Skrjabin specimens revealed that they fall within the same range of variation observed in other *B. capitatum* examined by us (Table 1).

PROBOSCIS ARMATURE: Porta (1906) described 12–18 *transverse* rows of hooks on the proboscis of *B. capitatum.* In his 2 later papers (Porta, 1908, 1909), he omitted the word "transverse" and referred only to 12–18 rows of hooks. Meyer (1932), Petrochenko (1958), and Yamaguti (1963) incorrectly interpreted Porta's descriptions as 12–18 *longitudinal* rows of hooks, without data on the number of hooks per "longitudinal" row. Actually, neither the number of longitudinal rows of hooks nor the number of hooks in each transverse row was given by Porta in any of his papers. However, the 12–18 transverse rows of hooks translates into 6–9 hooks per longitudinal row, because of the alterating "transverse" arrangement of hooks in adjacent longitudinal rows.

Delyamure (1955) correctly cited the number of *transverse,* i.e., circular, rows of hooks as 12–18; his description of 18–20 longitudinal rows may have come from Baylis (1929), who stated "18 (–20?)." We can not determine the source of the Baylis (1929) number. Edmonds (1957) gave a formula of 14–16 longitudinal rows of 8 hooks each. Yamaguti (1963) cited these numbers also, attributing them to Edmonds (1957), who later (Edmonds, 1987) reported 15–17 longitudinal hook rows from an additional collection.

Kikuchi and Nakajima's (1991) description of 10–20 longitudinal rows must be considered a typographical error for 16–20 rows, which is the number given in Kikuchi and Nakajima's 1993 description (16–20 in males, 18–20 in females). In their 1991 abstract, they report 12–16 circular (transverse) rows of hooks on the proboscis. In their 1993 paper, the number of transverse rows was given as 12–18 in males and 15–18 in fe-

males. This translates into 6–9 hooks per longitudinal row in males and 7–9 in females.

In *B. physeteris,* Delyamure (1955) described 6–8 hooks per row in both sexes, with variations in females of 6–7 or 7–8. Delyamure (1955) examined 7 specimens collected by Gubanov from the sperm whale. Petrochenko (1958) reported 6–8 hooks per row in males (with variations from 5–6 to 7–8) and armature in females "almost the same" as in males. There is no indication that Petrochenko examined any specimens. He noted that his description was taken from Gubanov (*in* Delyamure, 1955), which was a thesis. This leaves open the question of why Petrochenko (1958) gave a range of 6–8 when he quotes the variations as 5–6 to 7–8, i.e., 5–8. This is the range given in a comparative table by Skrjabin (1959). Otherwise, the data in Skrjabin's (1959) table appear to be taken from Delyamure (1955). The number of longitudinal rows of proboscis hooks appears to be 18–20 in *B. physeteris.* Both Delyamure (1955) and Petrochenko (1958) report the same number. The key by Petrochenko (1958) has a strange error; there are no characters leading to *B. physeteris.* The number of 20–24 longitudinal rows of hooks applies to "*Bolbosoma serpenticola* (Fukui, 1929) Meyer, 1932" (=*Diplospinifer serpenticola* Fukui, 1929). Skrjabin (1970) gives the hook numbers as 20–24 by 7–8, which is the result of failing to recognize the error in Petrochenko's (1958) key.

Conclusions

The interbulbar spine pattern in all specimens described in the literature or examined in this study (Table 1) falls within the range of 0–3 transverse rows in *B. capitatum* as established above. Similarly, proboscis armature is basically the same, irrespective of host or geographical distribution. Also, the size and shape of proboscis hooks, roots, bulb spines, trunk, proboscis, proboscis receptacle, and eggs are similar. These similarities also include those of *B. physeteris.* A comprehensive comparative listing of measurements of these structures, among others, will not be attempted. The following, however, should be noted. Only 2 sets of hook measurements were given for *B. physeteris* proboscis hooks. Measurements of its "anterior hooks" (actually, the middle hooks) are similar to those middle hooks of other *B. capitatum* populations. The size of bulb spines of *B. physeteris* is the same as that given for the larger of these spines in *B. capitatum* by Kikuchi and Nakajima (1993).

It is concluded that in the absence of any outstanding difference justifying the retention of a specific status for *B. physeteris,* this species becomes a junior synonym of *B. capitatum.* It is further concluded that all populations of *Bolbosoma* examined in this study and included in Table 1 (except the last collection) belong in *B. capitatum.*

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1998–1999 Meeting Schedule

14 October 1998	Walter Reed Army Institute of Research, Washington, DC, 7:30 pm (Contact person: Joan Jackson, 202-782-1236)
18 November 1998	Anniversary Dinner—Meeting Location TBA
20 January 1999	Armed Forces Institute of Pathology (WRAMC), Washington, DC, 7:30 pm (Contact person: Ronald Neafie, 202-782-1829)
10 March 1999	Uniformed Services University of the Health Sciences, Bethesda, MD, 7:30 pm (Contact person: John Cross, 301-295-3139)
8 May 1999	University of Pennsylvania, New Bolton Center, Kennett Square, PA, 2:00 pm (Contact person: Jay Farrell, 215-898-8561)